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Measuring OH Reaction Rate Constants and Estimating the Atmospheric Lifetimes of Trace Gases.

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Reactions with hydroxyl radicals and photolysis are the main processes dictating a compound's residence time in the atmosphere for a majority of trace gases. In case of very short-lived halocarbons their reaction with OH dictates both the atmospheric lifetime and active halogen release. Therefore, the accuracy of OH kinetic data is of primary importance for the comprehensive modeling of a compound's impact on the atmosphere, such as in ozone depletion (i.e. the Ozone Depletion Potential, ODP) and climate change (i.e. the Global Warming Potential, GWP), each of which are dependent on the atmospheric lifetime of the compound.

We have demonstrated the ability to conduct very high accuracy determinations of OH reaction rate constants over the temperature range of atmospheric interest, thereby decreasing the uncertainty of kinetic data to 2-3%. The atmospheric lifetime of a well-mixed compound due to its reaction with tropospheric hydroxyl radicals can be estimated by using a simple scaling procedure that is based on the results of field observations of methyl chloroform concentrations and detailed modeling of the OH distribution in the atmosphere.

The currently available modeling results of the atmospheric fate of various trace gases allow for an improved understanding of the ability and accuracy of simplified semi-empirical estimations of atmospheric lifetimes. These aspects will be illustrated in this presentation for a variety of atmospheric trace gases.